## CLAIMS

We claim

1. An apparatus having a plurality of sensors that monitor materials properties of a liquid medium, said apparatus comprising

a flow channel of predetermined shape and dimensions, said flow channel being a path for a flow of said liquid medium, whereby said liquid medium is contiguous with a surface of said flow channel;

a metal housing of predetermined shape and dimensions surrounding said flow channel, said metal housing comprising an upper half and a lower half that are contiguous;

a first plurality of sensor ports in said metal housing for providing said plurality of sensors access to said liquid medium;

a first recess of predetermined shape and dimensions in said lower half for receiving a first ceramic block of predetermined shape and size thereby creating an exposed planar surface of said first ceramic block that is contiguous with said flow channel;

a second recess of predetermined shape and dimensions in said upper half for receiving a second ceramic block of predetermined shape and size thereby creating an exposed surface of said second ceramic block that is contiguous with said flow channel said second ceramic block disposed opposite and facing said first ceramic block;

a first lead electrode that is disposed on said exposed planar surface of said first ceramic block and a second lead electrode that is disposed on said exposed planar surface of said first ceramic block said second lead electrode does not touch said first lead electrode;

a first multitude of finger electrodes of predetermined shape and dimensions said first multitude of finger electrodes disposed on said exposed planar surface of said first ceramic block so that no finger electrode touches any other said finger electrode and so that said first multitude of finger electrodes is contiguous with said first lead electrode;

a second multitude of finger electrodes of predetermined shape and dimensions disposed on said exposed planar surface of said first ceramic block so that no said finger electrode touches any other said finger electrode and said second multitude of finger electrodes is contiguous with said second lead electrode, said first multitude of finger electrodes and said second multitude of finger electrodes are interleaved and alternately disposed means for forming interdigitating electrodes disposed on said exposed planar surface of said first ceramic block so that said first multitude of finger electrodes and said second multitude of finger electrodes are not touching;

a first detector means for measuring electrical admittance of said interdigitating electrodes said detector means connected across said first lead electrode and said second lead electrode;

an interchange channel of predetermined shape and dimensions that is aligned with and contiguous with said flow channel and is sandwiched between said flow channel and machine means for pumping said liquid medium into said interchange channel said interchange channel aligned with said machine means, whereby said interchange flow channel directs said flow of said liquid medium into said flow channel;

a metal adapter plate of predetermined shape and dimensions surrounding said interchange channel said metal adapter plate sandwiched between said metal housing and said machine means for pumping said liquid medium said metal

adapter plate contiguous with said metal housing and said machine means for pumping said liquid medium;

a first means for controlling temperature of said metal housing and said metal adapter plate;

a plurality of detectors means for measuring responses from said plurality of sensors;

2. An apparatus in accordance with claim 1, wherein said flow channel has a cross sectional shape of a slit with a width that is greater than ten times a height.

3. An apparatus in accordance with claim 1, wherein a length of said flow channel is long enough to accommodate said plurality of sensor ports in said metal housing means for forming a slit sample chamber with fixed said height along entire said length.

4. An apparatus in accordance with claim 1, wherein said plurality of sensors is selected from a group comprising a pressure sensor and a temperature sensor and an electric sensor and a dielectric sensor and an ultrasonic sensor and an optical sensor and a magnetic sensor and a mechanical sensor and a radiation sensor and an ultraviolet absorption sensor and an infrared absorption sensor and a microscopy image sensor and any sensor means for measuring said materials properties of said liquid medium.

5. An apparatus in accordance with claim 1, wherein said finger electrodes of said interdigitating electrodes have identical predetermined shape and dimension.

6. An apparatus in accordance with claim 5, wherein each said finger electrode is separated from its nearest neighbor by a predetermined identical distance so as to control a spatial definition of a fringing electric field inside said flow channel.

7. An apparatus in accordance with claim 6, wherein said interdigitating electrodes are oriented at a predetermined angle with respect to a flow direction of said liquid medium.

8. An apparatus in accordance with claim 6, wherein a first said interdigitating electrodes of first predetermined shape and dimension and angle with respect to said flow direction and a second said interdigitating electrodes of second predetermined shape and dimension and angle with respect to said flow direction are disposed on said exposed planar surface of said first ceramic block means for producing first said fringing electric field and second said fringing electric field so that first said fringing electric field and second said fringing electric field have different direction and said spatial definition.

9. An apparatus in accordance with claim 1, further including a lifting bolt means for removing said first ceramic block from said first recess in said lower half.

10. An apparatus in accordance with claim 1, further including an additional instrument sensor sector comprising a second plurality of sensor ports said additional instrument sensor sector sandwiched between and contiguous with said metal adapter plate and said metal housing said additional instrument sensor sector surrounding a sector channel that is aligned with said flow channel and said interchange flow channel.

11. A method for measuring dielectric properties of said liquid medium comprising the steps of

(a) setting a predetermined temperature of said metal housing and said metal adapter plate using said first means for controlling temperature;

(b) providing an alternating current voltage of predetermined magnitude and predetermined frequency;

(c) applying said alternating current voltage to said interdigitating electrodes;

(d) measuring a first current through said interdigitating electrodes when said flow channel is occupied by air;

(e) providing said liquid medium in said flow channel;

(f) measuring a second current through said interdigitating electrodes when said flow channel is occupied by said liquid medium;

(g) subtracting said second current from said first current means for obtaining a third current;

(h) separating said third current into a first part that is in phase with said alternating current voltage and a second part that is out of phase with said alternating current voltage;

(i) dividing said first part by said alternating current voltage and by a predetermined calibration factor means for obtaining a dielectric loss of said liquid medium;

(j) dividing said second part by said alternating current voltage and by said predetermined calibration factor means for obtaining a relative permittivity of said liquid medium;

(k) repeating steps b through j at a multitude of predetermined frequencies means for obtaining a dielectric spectrum of said liquid medium;

(l) repeating steps a through k at a multitude of predetermined temperatures, means for obtaining a temperature dependence of said dielectric spectrum.

12. A method in accordance with claim 11, wherein said predetermined magnitude of said alternating current voltage is 1 volt.

13. A method in accordance with claim 11, wherein said multitude of predetermined frequencies is within the range $10^{-3}$ Hz to $10^{7}$ Hz.

14. A method in accordance with claim 11, wherein said liquid medium is a molten polymer composite.

15. An apparatus for flushing said slit sample chamber comprising said surface of said slit sample chamber with predetermined said width and said height means for applying shear stress to said liquid medium when it is flowing whereby first said liquid medium is replaced with second said liquid medium in said slit sample chamber after said second said liquid medium has been introduced to said flow channel.

16. A apparatus for measuring optical properties of said liquid medium comprising

a light source with radiation at visible wavelengths said light source projecting a first beam of light;

a first means for selecting a narrow chromatic band of light from said light source said first means disposed so that said first beam of light transmits through said first means thereby creating a second beam of light;

a beam splitter means for separating said second beam of light into a third beam of light and a fourth beam of light said beam splitter aligned with said light source;

a second detector means for detecting first light intensity of said third beam of light said second detector means aligned with said beam splitter;

a first optical fiber means for transmitting said fourth beam of light to a focusing lens means for focusing said fourth beam of light;

a light transparent sapphire window contiguous with and flush with said surface of said flow channel said light transparent sapphire window disposed to transmit said fourth beam of light through said flow channel;

a reflecting surface disposed facing said light transparent sapphire window on opposite side of said flow channel;

a second optical fiber means for collecting a fifth beam of light reflected from said reflecting surface said fifth beam of light transmitting through said flow channel and through said sapphire window and through said focusing lens to said second optical fiber means;

a third detector means for measuring a second light intensity of said fifth beam of light transmitted by said second optical fiber means said third detector means aligned with said second optical fiber means;

a calculator means for determining a ratio of said second light intensity to said first light intensity whereby said ratio is a light transmission coefficient of said liquid medium when said liquid medium occupies said flow channel.

17. An apparatus in accordance with claim 16, wherein said light source is an incoherent xenon arc lamp.

18. An apparatus in accordance with claim 16, wherein said light source is an incoherent halogen lamp.

19. An apparatus in accordance with claim 16, wherein said light source is a laser.

20. An apparatus in accordance with claim 16, wherein said first optical fiber means is a single optical fiber with a predetermined first core size and first length.

21. An apparatus in accordance with claim 16, wherein said second optical fiber means is six optical fibers each having said predetermined first core size and second length.

22. An apparatus in accordance with claim 16, wherein said second detector means and said third detector means are photomultiplier tubes.

23. An apparatus in accordance with claim 16, wherein said second detector means and said third detector means are photodiodes.

24. An apparatus in accordance with claim 16, wherein said third detector means is a monochromator for measuring a wavelength spectrum of said fifth beam of light.